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Conceptualizing Space Elevators and Tethered Satellites (3)

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A JOURNEY OF STUDENT SPACE ELEVATOR DEVELOPMENT

Abstract

"We want to build a Space Elevator!" - With this idea in mind, a student group from Munich, Germany, has been delivering Space Elevator concepts and climber prototypes since 2005. This paper tells their story and presents technical details of a successful Space Elevator evolution, focused on practical research in climber technology. Within this paper, the former students who drew the first concepts, retrace and document a 13 year journey. It presents the technological milestones in climber development, their success in competitions and their efforts to establish an international Space Elevator competition in Europe.

The group was founded as part of the *Scientific Workgroup for Rocketry and Spaceflight* (German abbr.: WARR) when NASA committed 200 k$ towards the *Power Beaming Challenge* and the historic idea of a Space Elevator became popular again. The team targeted to achieve the required 1 m/s ascent rate with a light-weight climber design and microwave power beaming. Although all components proved to work in the end, an underestimation of time and budget prevented the team from participating at NASA's climbing challenges in 2007 and 2009.

Driven by the challenges of NASA, JSEA's *Japan Space Elevator Technical and Engineering Competition* (JSETEC), later called *Space Elevator Challenge* (SPEC), and WARR's own *European Space Elevator Challenge* (EUSPEC), the group ran through a technical evolution: from the first LEGO prototype through five generations of rope and tether climbers towards today's highly integrated climbing module, mostly built from composite materials. Its drive assembly includes an 8 kW electrical motor to achieve a vertical speed of up to 35 m/s.

After several years of climber development and participating in international competitions, the group decided to establish a Space Elevator competition of their own. With a unique focus on energy efficiency and payload carrying capability, the European Space Elevator Challenge was hosted at TUM in 2011, 2012 and 2016, with climbing heights of up to 100 m. Many unique concepts were presented by the participating teams and both design quality and climber performance improved over time. Currently, EUSPEC and SPEC are the only remaining climber competitions worldwide.

Over the years, the group was able to introduce the Space Elevator concept to the interested public through media events and conference attendances. It established contacts with the vibrant Japanese Space Elevator community and the *EuroSpaceward Foundation*. For successful future development of the Space Elevator, international cooperation is essential and practical research complements ongoing theoretical work in the research community.